

National Climatic Data Center

DATA DOCUMENTATION

FOR

DATA SET 6430 (DSI-6430)

USDA/NRCS SNOTEL - Daily Data, Text Reports

December 13, 2002

National Climatic Data Center
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1. **Abstract:** The SNOTEL data collection network, operated by the [National Water and Climate Center](#) (NWCC), [Natural Resources Conservation Service](#) (NRCS), of the US Department of Agriculture (NWCC/NRCS/USDA) since the mid-1970's, was established to support water supply assessment and forecast responsibilities of the NRCS. Approximately 75% of the water needs of the Western USA are supplied from the annual melt water of mountain snow packs. Monitoring the accumulation and depletion of the snow pack in this region is critical for stream flow and reservoir management and for all users of the region's water supply. The growing SNOTEL (*SNOWpack TELemetry*) data collection is also becoming more valuable for the study of climate and climate change, providing daily data from previously unavailable remote alpine regions.

The system evolved from NRCS's Congressional mandate in the mid-1930's "to measure snowpack in the mountains of the West and forecast the water supply." The programs began with manual measurements of snow courses; since 1980, SNOTEL has reliably and efficiently collected the data needed to produce water supply forecasts and to support the resource management activities of NRCS and others.

The SNOTEL network currently consists of some 640 sites located in 13 Western US states (including Alaska) that are equipped with automated instruments that measure snow-water equivalent, surface temperatures and precipitation. Data are collected continuously (normally every 15 minutes, sometimes at a greater resolution) and transmitted by microburst technology 1 to 4 times per day to master receiving stations and then on to the NWCC data processing office in Portland, Oregon. Data in this data set are a once-daily resolution from the midnight observation that has received some quality control from NRCS Data Collection Offices. (The existence of additional observations varies throughout the network and by event, and is not quality controlled. Contact the NWCC for more information.)

Daily snow-water equivalent is measured by the weight of the snow pack on a "snow pillow", a fluid filled plastic or steel flat pouch with hydraulic connections to a manometer, or pressure measuring device. Manometer pressures are converted to equivalent "inches of precipitation" values.

Air temperatures are measured by YSI (Yellow Springs Instruments) thermistors, in NRCS-designed housings. The standard height of the sensor above ground level (AGL) is in debate presently, with some sensors installed 20 feet AGL, and others installed at a height of one meter above the maximum snowpack.

Daily accumulated precipitation is measured by the weight of accumulated precipitation in a storage rain gauge equipped, like the snow pillow, with hydraulic connections to a manometer. Manometer pressures are converted to equivalent "inches of precipitation" values. The storage rain gauges are emptied and recharged annually and contain antifreeze and oil to prevent freezing and evaporation of accumulated precipitation. Storage rain gauges in severe alpine winter conditions will sometimes experience a total snow blockage of the orifice. When this occurs, the storage gauge precipitation values will show no accumulation during incidents of snow pillow water-equivalent accumulation gains; followed by a sudden jump in storage gauge accumulated precipitation when the snow cap collapses into the gauge.

Data processing and quality control includes continuous monitoring of data transmissions, data recovery from power outages, and basic real-time consistency and validation checks by the NWCC in Portland, Oregon; and higher

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level quality control checks and adjustments performed by staff at six NRCS Data Collection Offices located in various NRCS State Office locations.

Data have been transferred from text report files provided by the US Department of Agriculture (USDA), Natural Resources Conservation Service (NRCS), National Water and Climate Center (NWCC). Three types of differently formatted report files have been sorted and merged onto one archive file at the NCDC. A header variable describing report type and sequence information has been added to each record of the archive file to preserve the original report structure but allow for a serial station sorting of the records.

Archive file organization. Three types of reports appear on the archive file as follows (all records on all reports are fixed length at 100 characters):

- a. **County Name Reference Report**
-One report
- b. **Station Metadata Reports**
-Thirteen reports sorted by state
- c. **SNOTEL Data Reports**
-Several thousand reports sorted by state, station and water year

2. Element Names and Definitions:

Archive File Header Variable. Each record on the archive begins with a header variable of the format:

AABBCCCCCDDDEEEEEE

where AA is the two-digit FIPS state number
 BB is the two-character FIPS state code
 CCCCCC is the six-character station/site identifier
 DDDD is the water year for a data report, and
 EEEEEE is the record sequence number within a report.

The report type is implied in the header variable by the presence of zero-filled components.

For the **County Name Reference Report**, header components AA, BB, CCCCCC and DDDD are set to zero:

example:
00000000000000000001
00000000000000000002
00000000000000000003
etc.

For the **Station Metadata Reports**, header components CCCCCC and DDDD are set to zero:

example:
02AK0000000000000001
02AK0000000000000002
02AK0000000000000003
etc.

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The **SNOTEL Data Reports** do not have any zero-filled components:

```
example:
02AK46P04S196600001
02AK46P04S196600002
02AK46P04S196600003
etc.
```

County Name Reference Report. This report shows a reference association between the FIPS three-digit county code within each state and the county name. States and counties are sorted in alphabetical order. No specific formatting is documented here; note that state name headers are imbedded within the list.

Depiction of the beginning of the County name Reference Report:

```
00000000000000000001County FIPS Codes by State      06/19/1998
00000000000000000002
00000000000000000003
00000000000000000004      st_cd cnty_cd cnty_nm
00000000000000000005Alaska - AK - 02
00000000000000000006      AK 010 ALEUTIAN ISLANDS (obsolete)
00000000000000000007      AK 020 ANCHORAGE
00000000000000000008      AK 030 ANGOON
000000000000000000xx.      . . .
000000000000000000xx.      . . .
000000000000000000xx      AK 282 YAKUTAT
000000000000000000xx      AK 290 YUKON KOYUKUK
000000000000000000xxArizona - AZ - 04
000000000000000000xx      AZ 001 APACHE
000000000000000000xx      AZ 003 COCHISE
```

Station Metadata Reports. These reports, sorted on state and sequence number, contain basic SNOTEL station/site metadata. The first three lines of each state Metadata Report depict a table with column headings, designed for printing ASCII file reports. The Station Metadata Report for South Dakota appears as follows:

```
46SD0000000000000001
46SD0000000000000002 No. ST CTY Type      HUC Station Lat. Long. Elev. Sitename
46SD0000000000000003 --- -- --- -----
46SD0000000000000004   1 46 103 SNOT 10120110 03E03S 4406 10358 6890 BLIND PARK
46SD0000000000000005   2 46 103 SNOT 10120110 03E04S 4407 10348 5900 MAITLAND DRAW
46SD0000000000000006   3 46 081 SNOT 10120110 03E05S 4412 10347 6130 NORTH RAPID
CREEK
```

The actual metadata begins in Sequence Number 00004 of each state's report and is formatted as follows:

| Columns | Field Length | Variable Type | Variable Name |
|---------|--------------|---------------|-------------------------------|
| 01 - 19 | 19 | character | Header Variable |
| 20 - 23 | 4 | integer | Line Sort Number (No.) |
| 24 | 1 | - | <blank> |
| 25 - 26 | 2 | character | FIPS State Number (ST) |

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| | | | |
|---------|----|-----------|-------------------------------------|
| 27 | 1 | - | <blank> |
| 28 - 30 | 3 | character | FIPS County Code (CTY) |
| 31 | 1 | - | <blank> |
| 32 - 35 | 4 | character | Data Type (Type) |
| 36 | 1 | - | <blank> |
| 37 - 44 | 8 | character | Hydrologic Unit Code (HUC) |
| 45 - 47 | 3 | - | <blank> |
| 48 - 53 | 6 | character | Station Identifier (Station) |
| 54 | 1 | - | <blank> |
| 55 - 58 | 4 | character | Latitude (Lat.) |
| 59 | 1 | - | <blank> |
| 60 - 64 | 5 | character | Longitude (Long.) |
| 65 | 1 | - | <blank> |
| 66 - 70 | 5 | integer | Elevation (Elev.) |
| 71 | 1 | - | <blank> |
| 72 - 91 | 20 | character | Station Name (Sitename) |

- a. **Line Sort Number:** Used in the original presentation of the Station Metadata Report to keep the station list in alphabetical order. (This dataset application uses the record sequence number from the header variable, described in Section 4.)
- b. **FIPS State Number:** Two-digit number representation for a state, according to the Federal Information Processing Standard (FIPS) publication 6-4, as follows:

| | |
|-----------------|-------------------|
| 02 - Alaska | 35 - New Mexico |
| 04 - Arizona | 41 - Oregon |
| 06 - California | 46 - South Dakota |
| 08 - Colorado | 49 - Utah |
| 16 - Idaho | 53 - Washington |
| 30 - Montana | 56 - Wyoming |
| 32 - Nevada | |
- c. **FIPS County Code:** Three-digit number representation for a USA county or county-equivalent entity within a state, according to FIPS publication 6-4. A list of all counties for the 13 SNOTEL states is contained in the **County Name Reference** report (described in Section 4).
- d. **Data Type:** Always contains "SNOT" for SNOTEL data type.
- e. **Hydrologic Unit Code:** Eight-digit number representation of a US Geologic Survey (USGS) drainage area, according to the USGS standard.
- f. **Station Identifier:** Six-character identifier of an individual station, maintained by the NWCC to be used as the relational link between the **Station Metadata Reports** and the **SNOTEL Data Reports**.
- g. **Latitude:** Latitude of a station in degrees and whole minutes; north latitude implied for all SNOTEL stations.
- h. **Longitude:** Longitude of a station in degrees and whole minutes; west longitude implied for all SNOTEL stations; all SNOTEL stations have longitudes > 100 degrees.

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- i. **Elevation:** Ground elevation of a station in whole feet.
- j. **Station Name:** Station name assigned by the NWCC.

Note: SNOTEL stations, being in remote areas, usually have names descriptive of natural features, such as 'Baker Butte.' SNOTEL stations incorporated into National Weather Service (NWS) gateway transmissions are often assigned new station names in the NWS Location Identifier data base according to the NWS convention of "nearest city + distance-direction". Thus, (fictional) SNOTEL station 'COPPER MOUNTAIN' may be known as "JACKSON 25 N in the NWS station data base.

SNOTEL Data Reports. These reports contain SNOTEL network climate and water data, sorted by state (number), station, water year and report sequence number. A "water year" extends from October 1 to September 30. (e.g. a report for water year 1990 contains data from October 1, 1989 through September 30, 1990.)

From one to five data elements are reported by each station in any given water year. These elements are shown as the report column labels **pill**, **tmax**, **tmin**, **tavg**, and **prec**, where:

pill = Snow water equivalent in inches, from a snow pillow,
tmax = Maximum temperature for the previous day in degrees Celsius,
tmin = Minimum temperature for the previous day in degrees Celsius,
tavg = Average temperature for the previous day in degrees Celsius, and
prec = Accumulated precipitation, on a water year basis, in inches.

All sites do not observe all of these data elements. Those elements observed by a site will appear as column headings in the above order. To illustrate, a station observing all five elements will show these column headings in this order:

pill tmax tmin tavg prec

A station observing only temperature and precipitation data elements will show these column headings in this order:

tmax tmin tavg prec

A station observing only snow and precipitation data elements will show these column headings in this order:

pill prec

The number of elements observed by a station can vary from year to year; users should check the column headings for each report. Within a water year, a given element may not be present on all days; but a column heading will appear if element data exist for any days in a water year.

Two examples of SNOTEL Data Reports are shown below; Baker Butte, AZ, having all five data elements, for non-leap/water year 1997, and Anchor River Divide, AK, having two data elements, for leap/water year 1988:

*****example 1*****

:
:
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```

04AZ11RO6S199700001*/cdbs/az/snot04
04AZ11RO6S199700002
04AZ11RO6S199700003Station : 11R06S, BAKER BUTTE
04AZ11RO6S199700004-----
04AZ11RO6S199700005
04AZ11RO6S199700006                BAKER BUTTE
04AZ11RO6S199700007                *****
04AZ11RO6S199700008 DATE            pill      tmax      tmin      tavg      prec
04AZ11RO6S1997000099610 1          0.0      21.1      10.3      14.3      0.0
04AZ11RO6S1997000109610 2          0.0      21.0       9.5      13.7      0.0
04AZ11RO6S1997000119610 3          0.0      19.3       8.0      13.0      0.0
04AZ11RO6S1997000129610 4          0.0      19.8       7.3      12.5      0.0
.
.
.
04AZ11RO6S19970037097 927          0.0      16.2       9.7      12.2      25.4
04AZ11RO6S19970037197 928          0.0      22.4      10.3      14.7      25.5
04AZ11RO6S19970037297 929          0.0      24.4      10.7      15.9      25.5
04AZ11RO6S19970037397 930          0.0      24.5      12.7      16.9      25.5
04AZ11RO6S199700374-----

```

*****example 2*****

```

02AK51K053198800001*/cdbs/ak/snot02
02AK51K053198800002
02AK51K053198800003Station : 51K05S, ANCHOR RIVER DIVIDE
02AK51K053198800004-----
02AK51K053198800005
02AK51K053198800006                ANCHOR RIVER DIVIDE
02AK51K053198800007                *****
02AK51K053198800008 DATE            pill      prec
02AK51K0531988000098710 1          0.0       0.3
02AK51K0531988000108710 2          0.0       0.5
02AK51K0531988000118710 3          0.0       0.5
02AK51K0531988000128710 4          0.0       0.6
.
.
.
02AK51K05319880037188 927          0.0      38.5
02AK51K05319880037288 928          0.0      38.5
02AK51K05319880037388 929          0.0      38.5
02AK51K05319880037488 930          0.0      38.5
02AK51K053198800375-----

```

Report lines one through seven contain metadata information that are captured in the header variable and/or the Station Metadata Reports, and are used to depict a table with column headings, designed for printing ASCII file reports.

Report line eight contains the valid data elements in this format:

| Columns | Field Length | Variable Type | Variable Name |
|---------|--------------|---------------|--|
| 01 - 19 | 19 | character | Header Variable |
| 20 | 1 | - | <blank> |
| 21 - 24 | 4 | character | <column header 'DATE'> |
| 25 - 33 | 9 | - | <blank> |
| 34 - 37 | 4 | character | Elem1 (pill, tmax, tmin, tavg, or prec) |

```

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```


| | | | |
|---------|---|-----------|--|
| 38 - 41 | 4 | - | <blank> |
| 42 - 45 | 4 | character | Elem2 (tmax, tmin, tavg, prec or <blank>) |
| 46 - 49 | 4 | - | <blank> |
| 50 - 53 | 4 | character | Elem3 tmin, tavg, prec or <blank>) |
| 54 - 57 | 4 | - | <blank> |
| 58 - 61 | 4 | character | Elem4 (tavg, prec or <blank>) |
| 62 - 65 | 4 | - | <blank> |
| 66 - 69 | 4 | character | Elem5 (prec or <blank>) |
| 70 - 71 | 2 | - | <blank> |

Report lines 9-373/374 contain data values in this format:

| Field | Columns | Length | Variable Type | Variable Name |
|-------|---------|--------|-------------------|--------------------------|
| | 01 - 19 | 19 | character | Header Variable |
| | 20 - 21 | 2 | integer(99)* | Year |
| | 22 - 23 | 2 | integer(99)* | Month |
| | 24 - 25 | 2 | integer(99)* | Day |
| | 26 - 31 | 6 | - | <blank> |
| | 32 - 33 | 2 | - | <blank> |
| | 34 - 37 | 4 | decimal(-999.9)** | DataValue (Elem1) |
| | 38 - 39 | 2 | - | <blank> |
| | 40 - 45 | 4 | decimal(-999.9)** | DataValue (Elem2) |
| | 46 - 47 | 2 | - | <blank> |
| | 48 - 53 | 4 | decimal(-999.9)** | DataValue (Elem3) |
| | 54 - 55 | 2 | - | <blank> |
| | 56 - 61 | 4 | decimal(-999.9)** | DataValue (Elem4) |
| | 62 - 63 | 2 | - | <blank> |
| | 64 - 69 | 4 | decimal(-999.9)** | DataValue (Elem5) |
| | 70 - 71 | 2 | - | <blank> |

* only last two digits of year are shown; integer month and day values show blanks instead of leading zeros, e.g. March 9, 1994 = 94 3 9

** decimal data values have leading blanks and a moving negative ('-') sign, where appropriate, e.g. -0.7 or -24.3

- Year:** Year of the data value date, last two digits.
- Month:** Month of the data value date, shown as a 2-digit integer with no leading zeros.
- Day:** Day of the data value date, shown as a 2-digit integer with no leading zeros.

Date examples:

May 5, 1988 becomes "88 5 5"

June 24, 1991 becomes "91 624"

November 13, 1980 becomes "801113"

- DataValue (Elem#):** for five different elements as follows:

n1. **pill:** Data value for daily snow-water equivalent in inches and tenths, observed at midnight.

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n2. **tmax:** Data value for previous calendar day's maximum air temperature in degrees Celsius to tenths; the highest observed temperature value from among all observed on a day. (SNOTEL observations are normally taken every 15 minutes (96/day), and sometimes more frequently.)

n3. **tmin:** Data value for previous calendar day's minimum air temperature in degrees Celsius to tenths; the lowest observed temperature value from among all observed on a day. (SNOTEL observations are normally taken every 15 minutes (96/day), and sometimes more frequently.)

n4. **tavg:** Data value for previous calendar day's average air temperature in degrees Celsius to tenths, computed as a straight average of all values observed on a day. (SNOTEL observations are normally taken every 15 minutes (96/day), and sometimes more frequently.)

n5. **prec:** Data value of daily accumulated precipitation in tenths of inches, observed at midnight, calculated from the beginning of the water year (October St.).

3. **Start Date:** 19781001 for most states/stations, 19651001 for a small number of Alaskan stations

4. **Stop Date:** Ongoing.

5. **Coverage:** North America

- a. Southernmost Latitude: 32N
- b. Northernmost Latitude: 68N
- c. Westernmost Longitude: 164W
- d. Easternmost Longitude: 104W

6. **How to Order Data:**

Ask NCDC's Climate Services about the cost of obtaining this data set.
Phone: 828-271-4800
FAX: 828-271-4876
E-mail: NCDC.Orders@noaa.gov

7. **Archiving Data Center:**

National Climatic Data Center
Federal Building
151 Patton Avenue
Asheville, NC 28801-5001
Phone: (828) 271-4800.

8. **Technical Contact:**

National Climatic Data Center
Federal Building
151 Patton Avenue
Asheville, NC 28801-5001

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:
:

Phone: (828) 271-4800.

Natural Resources Conservation Service
National Water and Climate Center
101 SW Main Street, Suite 1600
Portland, Oregon 97204-3224

9. **Known Uncorrected Problems:** The Station Metadata Reports for Alaska show stations associated with invalid FIPS County Codes. This has occurred because the organization of county-equivalent areas in Alaska has been changing in recent decades, and SNOTEL sites need to be reviewed and placed in current county-equivalent areas. The County Name Reference Report has retained the invalid county codes and names for the time being and has marked them with the tag "(obsolete)".

10. **Quality Statement:** Data processing and quality control includes continuous monitoring of data transmissions, data recovery from power outages, and basic real-time consistency and validation checks by the NWCC in Portland, Oregon; and higher-level quality control checks and adjustments performed by staff at six NRCS Data Collection Offices located in various NRCS State Office locations.

11. **Essential Companion Datasets:** None.

12. **References:** No information provided with original documentation. Information on the NRCS can be obtained from:

<http://www.nrcs.usda.gov/>

and information on the NWCC and SNOTEL can be obtained from:

<http://www.wcc.nrcs.usda.gov/>